Impulsivity and Risky Decision-Making

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Abstract

The relationships between emotion, trait impulsivity, sensitivity to reward and punishment and risky decision-making were explored. Twenty-Seven undergraduate psychology students (14 males and 13 females) completed the (negative) Urgency, (lack of) Premeditation, (lack of) Perseverance, Sensation Seeking, and Positive Urgency scale (UPPS+P); the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ), and the Positive Affect and Negative Affect Schedule (PANAS). Afterward the participants performed the Iowa gambling task (IGT). Results showed that dimensions related to negative emotion and rash impulsivity significant factors within the model to predict risky decision-making during the IGT

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Impulsivity and Risky Decision-Making

Every day, people make a number of decisions that can vary in there consequences. How people come to make those decisions is a topic that has been studied by psychologists since the beginning of the science. In general to most of us, risky decision-making is thought of as a process that is illogical and unreasoned. Yet, the cause of what leads a particular individual to make risky choices is still unclear. In order to understand how one person comes to make a risky decision, it is necessary to examine what factors are leading to the risky decision-making.

Risky Behavior

Substance use as well as aggressive and antisocial behavior are considered to be risky activities (Cross, Copping, & Campbell, 2011). In addition, there are several other types of activities such as engaging in extreme sports or gambling which can be considered to be highly risky activities (Thomson & Carlson, 2014; Wilson & Daly, 1985). Differences between people who do engage in risky behavior, and those who do not, are widely studied and many different variables are involved (Krueger, Markon, Patrick, Benning, & Kramer, 2007). Gender differences are well documented between risky decision-makers and risk aversive decision-makers. In general men tend to engage in risky behavior at a higher rate than do women (Cross et al., 2011). Differences between genders in regards to risky decision-making are generally explained as a result of the evolution. Men are more incentivized to be aggressive and impulsive in order to establish intrasexual dominance in order to acquire mates (Daly & Wilson, 1983). However, there are other factors that do not see the same gender differences that also are

related to an increased level of risky behavior such as the lack of self-control (Cross et al., 2011). This means regardless of gender if you are not able to maintain self-control then you are likely to engage in risky behavior. One construct which has been associated with a lack of self-control, and motivation, in regards to gender differences, is impulsivity (Cross et al., 2011).

Impulsivity

The construct of impulsivity is considered to be a very heterogeneous (Miller, Flory, Lynam & Leukefeld, 2003). In order to try to encompass all of the heterogeneity into one model, four dimensions of impulsivity were identified by Whiteside and Lynam (2001) using the Five Factor Model of personality; this model is called the UPPS model. The dimensions include urgency, (lack of) premeditiation, (lack of) perseverance, and sensation seeking. Urgency refers to the likelihood to behave rashly or perform regrettable actions due to intense negative affect; or a lack of self-control due negative affect. (lack of) Premeditation refers to the delaying immediate gratification to carefully think and plan. (lack of) perseverance refers to the ability for someone to stay with a task until it is completed and avoid boredom. Sensation seeking refers to a person's likelihood to seek exciting experiences and adventure. Later Cyders et al. (2007) split urgency into two different types; one being the original type of urgency related to negative affect and the other related to positive affect. This model includes many constructs which are found to be associated with lack of effortful control (rash impulsivity) in risky decision-making (Cross et al., 2011).

Although this new model was able to encompass much of the heterogeneity of impulsivity, Carlson, Pritchard & Dominelli (2013) found that sensitivity to punishment and reward, both constructs of Reinforcement Sensitivity theory (RST; Gray, 1987; Gray & McNaughton, 2000), were able to add additional predictive information to the UPPS model when predicting disinhibited and aggressive behavior. RST includes three systems which are related to sensitivity to reward and punishment as well as approach and avoidance motivation. The Behavioral Activation System (BAS) is sensitive to positive and negative reinforcement, and when this system is activated it is related to approach behavior toward the reward or avoidance of the possible punishment. According the Carlson et al. (2013), the Behavioral Inhibition System (BIS) is conventionally viewed as being sensitive to conditioned punishments, but a more up-to date view now implicates it as playing an inhibitory role between the BAS and the third system of RST when conflicts between systems occur. The third system is the Flight-Flight-Freezing System (FFFS), this system is sensitive to stimuli that are regarded as aversive. Usually risky externalizing behaviors such as aggression, disinhibition and antisocial tendencies which relate to impulsivity are thought to be related to the sensitivity to reward of the BAS and the sensitivity to punishment of the BIS and FFFS (Carlson et al., 2013).

Taking into account both the UPPS model and the RST three main factors seem to predict reported risky behavior (Cross et al., 2011; Carlson et al., 2013). The three factors are rash impulsivity, sensitivity to reward and sensitivity to punishment. Using these three factors of impulsivity, Carlson et al. (2014; 2015) conducted studies examining downhill sport athletes' risk-taking. In Carlson et al. (2014) found that there was a

difference in reward and punishment sensitivity between people who participated in downhill sports and those who did not participate, but no difference in rash impulsivity. Carlson et al. (2015) found significant correlations between several measures of impulsivity and Contextual Sensation Seeking Questionnaire for skiing and Snowboarding (CSSQ-S) scores which measures sensation seeking during downhill sports. In addition, hierarchical regression including sex, age, reward sensitivity, punishment sensitivity and rash impulsivity was found to be significant, with punishment sensitivity and rash impulsivity being significant factors within the model. These two studies support the idea that risk taking behavior can be significantly predicted by these three constructs. However, it also suggests that there is a lot of variability within groups of people who do take risks. As Carlson et al. (2015) suggests once a risk taking behavior has been initiated it may be that rash impulsivity plays a greater role in risky decision-making than do motivational systems such as the BAS and BIS which may be related in beginning to participate in risk taking.

Current Study

This study sought to expand upon the current knowledge of the impulsivity and risky decision-making process by examining the relationships between of impulsivity, sensitivity to punishment and reward, emotion and risky decision-making. The UPPS model and RST models were tested to predict risky decision-making. In concordance with Carlson et al. (2015), it was hypothesized that rash impulsivity and punishment sensitivity will correlate with risky decision-making.

In order to expand upon previous studies involving rash impulsivity, reward sensitivity and punishment, trait emotional disposition was recorded. Studies involving decision-making, specifically poor decision-making regarding future consequences, have implicated emotion and somatic states relating to emotional experience as an important factor informing an individual during the decision-making process (Bechara, Damasio, Damasio & Anderson, 1994; Damasio, 1994; Bechara, Damasio, Damasio, & Lee, 1999; Bechara, Damasio, Damasio, 2000). In addition, approach motivation and reward sensitivity have been associated with positive emotion, and inhibition and punishment have been associated with negative emotion (Davidson, 1992). Furthermore, the urgency dimensions of the UPPS model are directly tied to specific affective states. Due to the interrelatedness of these impulsivity constructs with emotion, it may be that trait emotional disposition also plays a role in the impulsive decision-making process that has not been accounted for in a model which attempts to predict risky decision-making. It is hypothesized that positive emotion will be positively correlated with risky decision-making due to its relatedness to the BAS and that negative emotion will be negatively correlated with risky decision-making due to its relatedness to the BIS and FFFS.

Similarly to Carlson et al. (2015) it is hypothesized that rash impulsivity dimensions of the UPPS model and punishment sensitivity of the RST will be significant factors within the model predicting risky decision-making. However, to expand upon this, trait emotional disposition will be included in the model to account for variability in risky decision-making due to emotion. It is hypothesized that by including negative emotional disposition into the model, constructs relating more to positive emotion will be less

influenced by negative emotion. This will allow for the effects of approach motivation related tendencies within constructs such as BAS and reward sensitivity to be more easily seen within the model predicting risky decision-making (Cross et al., 2011; Carlson et al., 2015). Including positive emotion into the model will cause the negative emotion, BIS/FFFS and punishment sensitivity variance of the impulsivity constructs to be more unique within the model and these should be negatively correlated with risky decision-making as found previously (Cross et a., 2011; Carlson et al., 2015). A possible pathway which may help to partially explain the way risky behavior occurs might be that factors such sensitivity to reward and punishment may influence a person's likelihood to choose to start a risky activity (Step 1; Carlson et al., 2015) and then factors such as emotional disposition play a role in the likelihood to behave rashly (rash impulsivity) while in the act of the activity (Step 2; Damasio, 1994). In order to study impulsivity traits and emotional disposition together, the Iowa gambling task (IGT) was used in this study to assess risky decision-making. The IGT is a gambling simulation game that requires participants to make 100 choices under ambiguous rules which only require that they keep picking cards and to try to win money over the course of the game (Bechara, Damasio, Damasio, & Anderson, 1994). It was hypothesized that factors relating to rash impulsivity and sensitivity to reward will be significant predictors within a model to predict risky decision-making during the IGT once negative trait emotion was included.

Method

Participants and Recruitment

27 undergraduates (13 females) between the ages of 18 and 25 years of age from the University of Minnesota Duluth participated in this study. All participants were recruited from introductory psychology courses through the University of Minnesota Duluth SONA system. The participants were given compensation in the form of a 10 dollar gift card to the campus bookstore.

Demographics

A brief questionnaire administered by the researcher was administered prior to data collection. Information recorded from the questionnaire included each participant's age, gender, dominant hand, and number of years in school.

Impulsivity Measure

The (Negative) Urgency, Premeditation, Perseverance, Sensation Seeking and Positive Urgency impulsive behavior scale (UPPS+P) assesses impulsivity on five different dimensions (Whiteside, & Lynam, 2001; Cyders, Smith, Spillane, Fischer, Annus, & Peterson, 2007). This scale's dimensions were created by utilizing a factor analysis of several impulsivity related scales. These scales included Dickman's functional and dysfunctional impulsivity scales (Dickman, 1990), the Barratt impulsiveness scale-11 (BIS-11; Patton, Stanford, & Wallace, 1995), the I-7 impulsiveness questionnaire (I-7; Eysenck, Pearson, Easting & Allsopp, 1985), multidimensional personality questionnaire control scale (MPQ; Tellegen, 1982), the temperament and character inventory (TCI; Cloninger, Przybeck, & Svrakic, 1991), the sensation-seeking scale (SSS; Zuckerman, 1994), the revised NEO personality inventory (NEO-PI-R; Costa & McCrae, 1992), and

additional impulsiveness items which were created to tap into more impulsive behaviors such as intense cravings (Whiteside & Lynam, 2001).

Negative urgency refers to the likelihood of experiencing powerful impulses as a result of being under the influence of negative emotions. Lack of premeditation refers to less thought being put into planning future activities and the reduced ability to reflect on the possible negative outcomes before behaving. Lack of perseverance refers to an individual's ability to stay focused on an activity that might be not be stimulating or is hard to complete (Whiteside & Lynam, 2001). Sensation seeking refers to an individual's likelihood to engage in activities that are exciting and to a person's openness to new experiences whether they are dangerous or not (Whiteside & Lynam, 2001). Positive urgency refers to the likelihood of experiencing powerful impulses as a result of being under the influence of positive emotions (Cyders et al., 2007). The UPPS+P has been shown to be a highly reliable measure when assessing impulsivity. Reliability coefficients for all of the dimensions are no lower than .81 and are as high as .93 (Weafer, Baggott, & de Wit, 2013). In addition, each dimensions of the UPPS+P has been shown to be distinctly different from the others (Whiteside & Lynam, 2001).

Sensitivity to Reward and Punishment

The Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ) assesses the Behavioral Inhibition system (BIS) and Behavioral Activation system (BAS), this is done by assessing anxiety about or sensitivity to the punishment dimension, and by assessing impulsivity or the sensitivity to reward dimension (Torrubia, R., Avila, C., Molto, J., & Caseras, X., 2001). According to Whiteside & Lynam (2001)

the BIS and BAS were originally created to incorporate Eysenck's ideas (Eysenck, et al., 1985) about personality with Gray's neuropsychological model (Gray, 1987) of approach and avoidance learning. Due to the lack of sensitivity of Gray's measure, Torrubia and colleagues created the SPSRQ to improve upon the original scales that measured the BIS and BAS. The result is that SPSRQ's subscales which include the BIS dimension, which is a measure of avoidance (withdrawal) motivation, and the BAS dimension, which is a measure of approach motivation. Both dimensions of the SPSRQ have been shown to be reliable through test-retest and behavioral studies (Avila, 1994; 1995; Caseras, Torrubia & Farre, 2001). The sensitivity to punishment scale has a reliability coefficient of .89 and the sensitivity to reward scale has a reliability coefficient of .87 (Torrubia et al., 2001).

Affect

Affect was measured by the Positive and Negative Affect Schedule (PANAS) (Watson, Clarke & Tellegen, 1988). The version used was the PANAS trait brief form. The PANAS scales consist of two 10-item scales which ask for reports of affect that the participants experience most of the time. The Positive Affect (PA) scale measures the extent to which a person feels enthusiastic, active and alert most of the time. The Negative Affect (NA) scale measures the aspect of distress, unpleasant engagement, which relates to aversive mood states such as anger, fear and disgust. Each scale has a possible score range between 10 and 50, 10 being low positive or negative affect and 50 being high positive or negative affect. This measure is useful because it allows for a consistent score to represent mood over time.

Iowa Gambling Task

The Iowa gambling task (IGT) is a gambling simulation game in which the participant's goal is to acquire as much fake money as he or she can through drawing 100 selections from a choice of four decks of cards (Bechara, Damasio, Damasio, & Anderson, 1994). Each participant started with a total of $2000 dollars in fake loaned money. The decisions that the participant makes during the task are motivated by the punishment or reward from the previous draw choices from each deck. Out of the four decks, two have increased risk but also have larger rewards and the other two decks have average reward where the risk of losing money is lower. At the end of the task the pattern of behavior that the participant exhibited allows for an index of punishment and reward sensitivity and motivation (Bechara, Damasio, Damasio, & Lee, 1999). A participant's performance can be evaluated based upon a score calculated by taking the number of safe deck choices minus the number of risky deck choices. A higher score means that the participant made more advantageous deck choices over the 100 deck choices.

Procedure

When participants arrived they were informed of the task and procedure that they would be asked to complete. Participants were then given a consent form to read and sign if they chose to proceed with the experiment. Upon receiving informed consent the participants completed the UPPS+P, the SPSRQ, and the PANAS self-report questionnaires on a laptop via Qualtrics. After the questionnaires, participants were asked to perform the IGT. Upon completion of the IGT, participants were debriefed and their time in the study was over.

Design and analysis

This study was a correlational design looking to examine the relationships between self-reported trait measures, risky decision-making during the IGT. Data analyses was conducted using SPSS Version 23.0 (IBM, 2010). Independent variables included scores on each dimension of the UPPS+P, SPSRQ, and the PANAS. The dependent variable was the score calculated from the choices made during the IGT. Linear regression was used to analyze the relationships between these variables.

Results

Preliminary correlational analysis revealed a strong relationship between two dimensions of the UPPS+P. There was a significant relationship between positive and negative urgency, $r(27) = .77$, $p < .001$ (two-tailed). This along with a poor collinearity diagnostics such as tolerance (PU = .219; NU = .313) and VIF (PU = 4.57; NU = 3.19), and a high residual correlation, $r(27) = .96$, $p < .001$, led positive and negative urgency to be combined into one sum score dimension now referred to as "Urgency". This new dimension encompasses both negative and positive emotionally driven impulsive behavior that would be captured by the negative urgency and positive urgency separately. All other dimensions of the scale were properly within an acceptable range of tolerance and VIF. Once the Urgency dimension was created collinearity between dimensions was not an issue. Correlations between risky decision-making and self-report questionnaires can be found on Table 1.

Hierarchical multiple regression analysis was conducted to predict risky decision-making during the Iowa gambling task. The regression used three steps, the first step included gender, the second included rash impulsivity (premeditation; perseverance;

urgency: UPPS+P), sensitivity to reward (SR scale: SPSRQ), and punishment sensitivity (Sensation Seeking: UPPS+P; SP scale: SPSRQ), and the third for trait negative disposition (NA scale: PANAS). Results show that after the third step the model accounted for 51% of the variance in risky decision-making on the Iowa gambling task, $F(8, 18) = 2.349$, $p > .05$. Including positive affect in the third step of the model did not cause a significant *F* change to occur. A summary of the results of the multiple regression analysis is found in Table 2.

Table 1.

Summary of Zero-Order r Analysis (N = 27)

	IGT	Gend	Preme	Perser	Urge	SR	SP	SS	NP	PP
IGT										
Gend	-.013									
Preme	-.253	.552**								
Perser	.114	.228	.404*							
Urg	.241	.190	.266	.471*						
SR	.262	.472*	.344	.294	.311					
SP	.304	-.215	-.401	.311	.611**	.047				
SS	-.281	-.552**	-.322	-.024	-.082	-.458*	.219			
NP	-.078	-.135	-.135	-.482*	-.186	.229	-.305	-.149		
PP	.019	-.085	-.080	.244	-.589**	.228	.556*	.284	.018	

Note. IGT = Iowa Gambling score; Gend = Gender; Preme = premediation; Perser = Perserverance; SS = Sensation Seeking; NU = Negative Urgency; PU = Positive Urgnecy; Urge = Urgency; NP = Negative PANAS; PP = Positive PANAS; SP = Sensitivity to Punishment; SR = Sensitivity to Reward.
** $p \leq .01$ (two tailed)
Table 2.

Summary of Hierarchical Regression Analysis Predicting IGT score (N = 27)

Variable	ΔR^2	*B*	*SE B*	β
Step 1	.000			
Gender		-.002	.039	-.013
Step 2	.387			
Gender		-.033	.051	-.170
Rash Impulsivity				
(lack of) Premeditation		-.181	.094	-.688
(lack of) Perseverance		.090	.099	-.233
Urgency		-.104	.074	-.499
Sensitivity to Reward				
SR scale		-.005	.006	.185
Sensitivity to Punishment				
SP scale		-.004	.007	-.235
Sensation Seeking		-.075	.048	-.359
Step 3	.124*			

Gender	-.037	.047	-.180
Rash Impulsivity			
(lack of) Premeditation	-.184	.087	-.700*
(lack of) Perseverance	.063	.092	.163
Urgency	-.156	.072	-.745*
Sensitivity to Reward			
SR scale	-.010	.006	.339
Sensitivity to Punishment			
SP scale	.-.003	.007	-.161
Sensation Seeking	-.035	.047	-.168
NA scale	-.008	.004	-.525*

Note. Step 1 F= .004, $p > .50$ (.950); Step 2 F change = 2.00, $p = .116$, $F = 1.715$, $p > .05$ (.186); Step 3 F change = 4.55, $p < .05$, $F = 2.254$, $p > .05$ (.063).

* $p < .05$

Discussion

The goal of this study was to examine the relationships between emotion, impulsivity and risky decision-making. The current study examined the relationships between scores on the UPPS+P, SPSRQ, PANAS, and IGT. Results of the correlational analysis did not reveal a significant zero-order correlation with risky decision-making,

although some seem to be approaching a significant level and an increase in power may reveal them to be significant. Results of the hierarchical regression indicate that the model was not statistically significant. However, there was a significant improvement in the model indicated by the *F* change statistic between step 2 and step 3. This means that the addition of negative affect significantly improved the model bringing unique variance that was not previously included. This finding may mean affect, especially negative affect is an important part of risky decision-making and that it should be considered as a part of future models which include rash impulsivity and sensitivity to reward and punishment when looking to predict risky behavior.

Previously Carlson et al. (2015) found that rash impulsivity and sensitivity to punishment were significant factors within a model to predict patterns of sensation seeking during skiing and snowboarding. The current study found that (lack of) premeditation and urgency, a dimension of rash impulsivity, as well as negative affect were significant factors within the model to predict risky decision-making during the IGT. In addition it seems as though sensitivity to reward was improved when negative affect was included but did not yet reach significance. Dimensions relating to sensitivity to punishment were not significant nor did they improve the model once negative or positive affect was included in a model. Although rash impulsivity was once again found to be a significant factor in predicting risky decision-making, an unexplainable relationship occurred so that more premeditation and less urgency predicted more risky choices. It could be that in the gambling scenario people who normally behave less rashly make more risky choices while gambling because they think they can plan to win in a

game of chance and therefore take the risks to win more money. This suggests that once again the relationships between rash impulsivity, sensitivity to reward and sensitivity to punishment are different than found previously. In the case of the IGT it seems as though the likelihood to make more risky choices is increased as a rash impulsivity decreases, negative affect increases, and possibly with increased sensitivity to reward.

Limitations and Future Direction

There were several limitations of this study. Limitations such as physiological data loss, small sample size, and study design could all be changed in the future in order to correct limitations of this study. Physiological data loss is a big limitation of this study. The study also included Electroencephalography (EEG) recording as well as galvanic skin response (GSR) recording and it was part of the basis for conducting the study. However, artifact and data loss during recordings in addition to low sample sized caused the data to be omitted from analysis. This data would have allowed comparison to other studies which also analyze constructs of impulsivity and comparison to other studies using the IGT. The EEG data would have been used to look at possible differences between hemispheric activation and risky decision-making as a result of differing levels of positive and negative emotion as well as levels of impulsivity. The GSR data would have been used to look at the relationship between autonomic response and decision-making as a result of differing levels of positive and negative emotion as well as levels of impulsivity. This data would have allowed the testing of hypotheses of the Somatic Marker Hypothesis (Damasio, 1994) as well as Davidson's (1992) theories about the nature of emotion being dominant to specific hemispheres.

Sample size is also a limitation of this study. A greater number of participants would have allowed for more data points to be used to create the regression model in the analysis. This would have allowed for a greater degree of power in the analysis. More power might have caused sensitivity to reward to be significant within the hierarchical regression model.

Lastly, the study's design is an issue that could be changed in future studies. If an experimental design was used to assess risky decision-making on the IGT that manipulated emotion presented to participants in groups of high versus low rash impulsivity, then effects of emotion in high versus low urgency could be more clearly seen in risky decision-making scores on the IGT. This would allow for conclusions to be drawn about the cause and effect nature of emotion and impulsivity in risky decision-making.

Conclusion

The current study, unlike previous studies used the UPPS+P, SPSRQ and PANAS in order to examine how dimensions of impulsivity and emotion relate to risky decision-making behavior. The results of the study suggest that emotion does play a unique role above and beyond impulsivity in risky decision-making. In this study, it seems as though people who do premeditate and normally exert effortful control make more risky decisions during the IGT when they normally experience less negative emotion and have increased sensitivity to reward. This interpretation may relate to gambling disorder and possibly to other non-substance-related disorders. Generally experiencing lower negative affect and having an increased sensitivity to reward may cause people to increase risky

plays while gambling or lead them to believe that they can win their money back as seen in the criteria for Gambling Disorder (American Psychiatric Association, 2013).

However, many more studies need to be done to determine the exact relationship between emotion, impulsivity and decision-making. In the future, physiological data will be needed in order to compare this behavioral and self-report data to findings from other studies which have obtained EEG and GSR data in relation to risky decision-making. Furthermore, until an experiment manipulates positive and negative emotion before or during the IGT, cause and effect cannot be concluded about the nature of emotion's influence on a person of either high or low rash impulsivity, or sensitivity to reward and punishment on risky decision-making during the IGT. It will be important in the future to address the limitations of this study and to improve upon its design.

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Appendix A.
IGT Instructions Presented

Appendix A.

IGT Instructions Presented

There are 4 decks of cards, you may choose in any order from the 4 decks. You may find all of them bad, but some are worse than the others. The goal of the game is to win as much money as possible. When you choose from the 4 decks you will always win some amount of money, this number will always be in green. Sometimes however a second number will appear, this number will be the amount of money that you lost and it will be red. The goal of the game is to maximize your winnings and to minimize your losses. No matter how much you find yourself losing, you can still win if you stay away from the worst decks. Although this is game, please treat the play money in this game as real money, and any decision on what to do with it should be made as if you were using your own money.